

# Problem Set #4

## CHM129

①

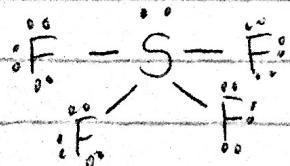
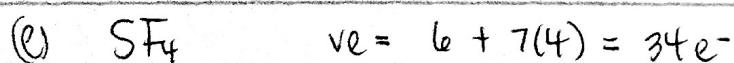
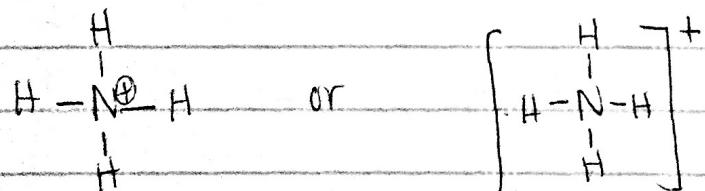
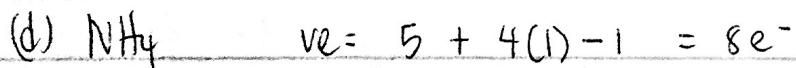
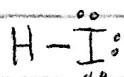
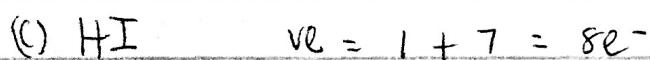
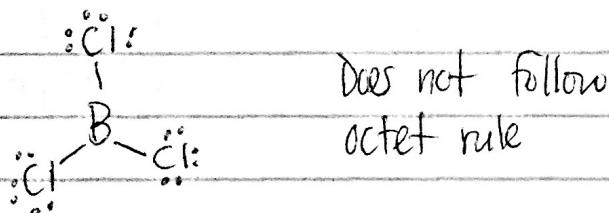
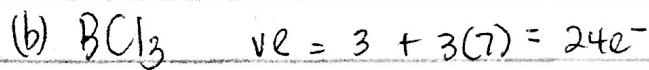
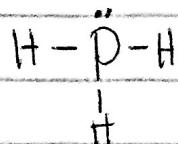
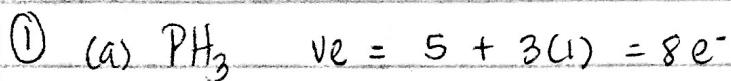
- ① (a) Al  $\rightarrow$   $\ddot{\text{A}}\text{l}^{\cdot}$
- (b)  $\text{Mg}^{2+} \rightarrow \text{Mg}^{2+}$  or  $[\ddot{\text{M}}\text{g}:]^{2+}$
- (c) Cl  $\rightarrow$   $:\ddot{\text{C}}\text{l}^{\cdot-}$
- (d)  $\text{Cl}^- \rightarrow [\ddot{\text{C}}\text{l}:]^-$

- ② (a) Br  $\notin$  Br  $\rightarrow$  nonpolar same electronegativity
- (b) C  $\notin$  Cl  $\rightarrow$  polar Cl more electronegative
- (c) Sr  $\notin$  O  $\rightarrow$  ionic O more electronegative
- (d) H  $\notin$  F  $\rightarrow$  polar F more electronegative

- ③ (a) NaF  $\rightarrow \text{Na}^+ [\ddot{\text{F}}:]^-$
- (b) CaO  $\rightarrow \text{Ca}^{2+} [\ddot{\text{O}}:]^{2-}$
- (c)  $\text{SrBr}_2 \rightarrow \text{Sr}^{2+} 2[\ddot{\text{Br}}:]^-$  or  $[\ddot{\text{Br}}:]^- \text{Sr}^{2+} [\ddot{\text{Br}}:]^-$  or  $\text{Sr}[\ddot{\text{Br}}:]_2$
- (d)  $\text{K}_2\text{O} \rightarrow 2\text{K}^+ [\ddot{\text{O}}:]^{2-}$  or  $\text{K}^+ [\ddot{\text{O}}:]^{2-} \text{K}^+$  or  $\text{K}_2[\ddot{\text{O}}:]^{2-}$

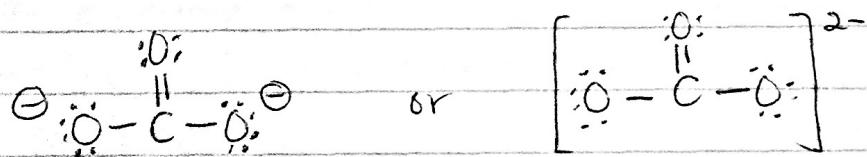
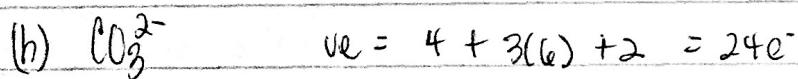
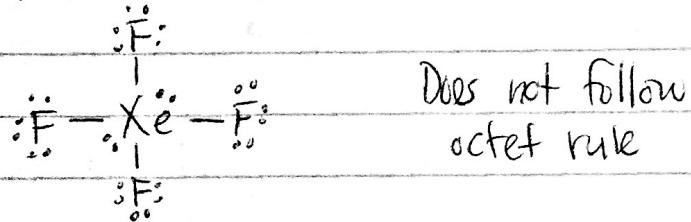
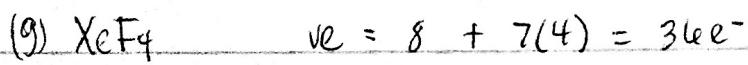
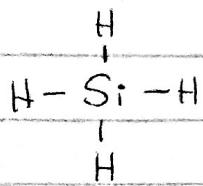
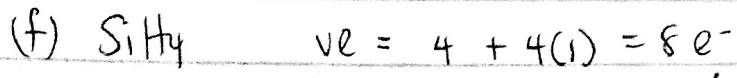
$\text{K}^+$  can also be shown as  $[\ddot{\text{K}}:]^+$

(2)

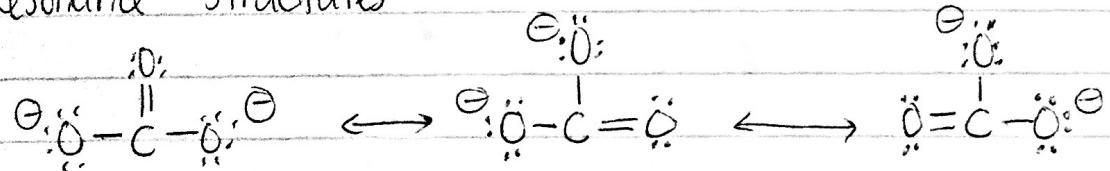


Does not follow  
octet rule

(3)



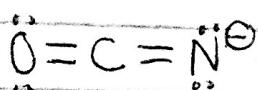
### Resonance Structures



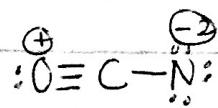
(4)



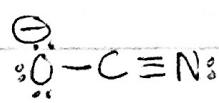
A



B



C



formal charges

$$\text{O} = 6 - 4 - \frac{1}{2}(4) = 0$$

$$\text{O} = 6 - 2 - \frac{1}{2}(6) = +1$$

$$\text{O} = 6 - 6 - \frac{1}{2}(2) = -1$$

$$\text{C} = 4 - 0 - \frac{1}{2}(8) = 0$$

$$\text{C} = 4 - 0 - \frac{1}{2}(8) = 0$$

$$\text{C} = 4 - 0 - \frac{1}{2}(8) = 0$$

$$\text{N} = 5 - 4 - \frac{1}{2}(4) = -1$$

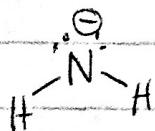
$$\text{N} = 5 - 6 - \frac{1}{2}(2) = -2$$

$$\text{N} = 5 - 2 - \frac{1}{2}(6) = 0$$

The preferred structure is C.:  $\ddot{\text{O}}^{\ominus}-\text{C}\equiv\text{N}:$

Structure B has larger formal charges than the other two and the positive charge is on the most electronegative atom. A and C have smaller magnitude formal charges but in structure C the negative charge lie on the most electronegative atom so, it is the structure that contributes the most to the actual  $\text{OCN}^-$  structure.

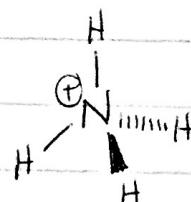
③



105°



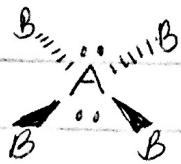
107°



109.5°

Each species has 4 electron groups around the N atom, but the number of nonbonding groups decreases from 2 to zero, going from  $\text{NH}_2^-$  to  $\text{N}^{\oplus}\text{H}_3$ . Since nonbonding groups exert greater repulsive forces on adjacent groups, the bond angles expand as the number of nonbonding groups decreases.

(5)

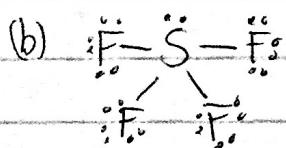
④  $\text{AB}_4$ Two nonbonding groups

The square planar molecular geometry is based on an octahedral electron group geometry. Four of the 6 electron groups are bonding groups and 2 are nonbonding groups.

⑤ (a)  $\text{H}-\text{C}\equiv\text{N}$ : $(\text{ve} = 10e^-)$ 

EG: Linear

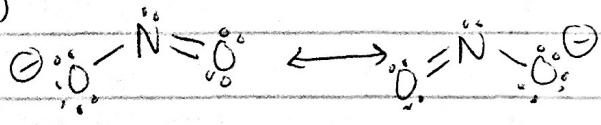
MG: Linear

 $(\text{ve} = 34e^-)$ 

EG: trigonal bipyramidal

MG: seesaw

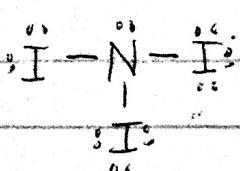
(c)

 $(\text{ve} = 18e^-)$ 

EG: trigonal planar

MG: bent

(d)

 $(\text{ve} = 26e^-)$ 

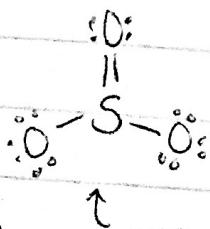
EG: tetrahedral

MG: trigonal pyramidal

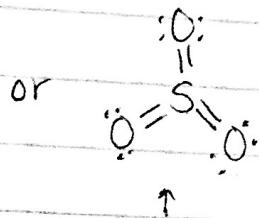
(6)

(VE = 24e<sup>-</sup>)

(e)



has 3 different structures

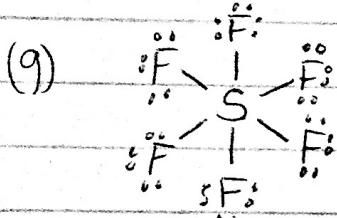


S can expand octet (all formal charges are zero)

EG: trigonal planar  
MG: trigonal planar(VE = 22e<sup>-</sup>)

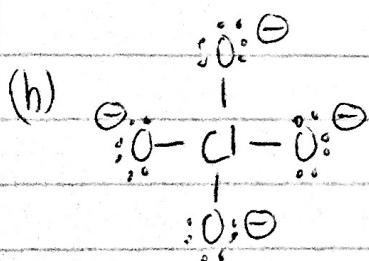
EG: trigonal bipyramidal

MG: linear

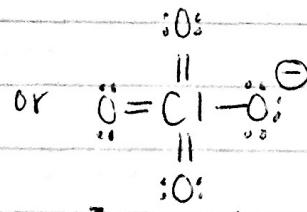


EG: Octahedral

MG: Octahedral

(VE = 48e<sup>-</sup>)

has 4 different structures

EG: tetrahedral  
MG: tetrahedral

Cl can expand octet (formal charges are smaller)